Mobile terminal with reduced components

5   The present invention relates to a mobile terminal having a first
processing unit, a first memory device and a SIM card chip having a second memory
device. Further it relates to a method for manufacturing a mobile terminal.

The invention relates in general to mobile terminals. There are different
market segments for mobile terminals and different user groups. Mobile terminals used
10   in the business area provide a lot of different functions, e.g. phoning, organizing,
Internet access, email client, camera device, etc.. It is obvious that these kind of mobile
terminals are high price devices. The contrary low cost devices are used in the first
place for phoning and maybe for messaging. However in most cases these low cost
mobile terminals have the same architecture as used in high price mobile terminals,
15   besides additional components such as cameras, which are not arranged in low cost
mobile terminals.

In the following a general architecture of a mobile terminal will be
described. A mobile terminal includes generally a transceiver unit, a display and a key
pad. Further a digital signal processing unit is used for processing, encoding and
20   decoding respective data. A main processing unit, also called base band processor, is
controlling the operation and the interaction between components of the mobile
terminal. Several non-volatile memory devices are arranged for storing different kinds
of data. There is a boot memory for storing a boot or start-up sequence and security
settings. A further non-volatile memory is a program memory for storing the operating
25   system, application software and general fixed data, as tables etc.. Further there is a
SIM card having a SIM card chip, which includes a SIM card controller and a SIM card
memory for storing network settings, the assigned phone number and user settings. A
further non-volatile memory is used for storing individual mobile terminal specific data,
which include parameters required to calibrate and set individual components of the
30   individual mobile terminal. The main processing unit uses a volatile random access
memory for storing temporary data. In most cases the non volatile memories for storing

the individual mobile terminal specific data and the operating system and application software are realised as Flash memory devices. This common architecture is used in both low cost mobile terminals and high price terminals.

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US 2003/0066881 A1 is related to a method for storing proprietary information in the SIM card of a mobile phone. It is described to store information of different manufactures on the SIM card.

Low cost mobile terminals are subject of a strong cost pressure, because 10 they are mostly used as prepaid devices of a mobile radio network provider. A general challenge is to develop mobile terminals, which are smaller and faster and having less power consumption and reduced costs.

15 Therefore it is an object of the present invention to provide a mobile terminal and a method for manufacturing a mobile terminal having a simplified and cost reduced architecture resulting in a low price mobile terminal.

The object of the invention is achieved by the features stated in the enclosed independent claims.

20 Further advantageous implementations and embodiments of the invention are set forth in the respective sub claims.

The invention bases on the thought, that the kinds of data which are required for operating a mobile terminal could be divided into mobile terminal independent data, which are fixed before assembling or manufacturing the mobile 25 terminal, and further into variable data to be set after assembling. This variable data comprises individual mobile terminal specific data, user and network specific data and security settings. The individual mobile terminal specific data are necessary to adjust e.g. parameters of components of the individual mobile terminal after manufacturing. Network specific data are used for operating the mobile terminal in a certain mobile 30 radio network and user data comprises e.g. phone numbers and addresses.

The invention provides a mobile terminal having a first processing unit, a first memory device and SIM card chip having a second memory device. The first and

second memory devices are embodied as non-volatile memories. The first memory device stores terminal independent data. These terminal independent data are stored before or during manufacturing of the mobile terminal. The variable data comprising individual mobile terminal specific data are stored in the second memory device. The

5   second memory device is disposed on the SIM card chip. The individual mobile terminal specific data are stored after the assembling procedure, whereas the times for storing the further kinds of variable data are different. Further kinds of variable data are: network and user depending data, which are also stored in the second memory device. Since each mobile terminal comprises a SIM card having a SIM card chip in

10   any case the SIM card chip including a controller and a memory device it is advantageously used as the second memory device for storing the individual mobile terminal specific data.

By assigning the different kind of data in this way the number of required non volatile memory devices is significantly reduced. A mobile terminal

15   according to the represent invention requires only two different kinds of non-volatile memory devices. The first memory device includes data which are fixed before manufacturing of the mobile terminal. The second memory stores all kind of data which will be stored after manufacturing. The second memory allows the erasure and restoring of data. The storing of variable data, especially the individual mobile terminal specific

20   data in the second memory located in the SIM card chip provides an improved protection of these data, since the data stored in the SIM card chip are further protected by the chip card controller. It is further advantageous to store the variable data in the second memory located in the SIM card chip, since there is a possibility to access these data via a SIM tool kit by an end to end communication via the mobile radio

25   connection.

The terminal independent data include the operating system and application software, wherein it is not intended to change the operating system and application software during the lifetime of the mobile terminal. Especially in low cost mobile terminals, which are normally not used as long as high price mobile terminals,

30   the need for upgrading the operating system or application software has a low priority. So these data are fixed before assembling the mobile terminal. Also the boot sequence and the fixed security settings are defined before assembling. So there is no need to

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store these kinds of data in high price EEPROM. According to the invention these data
will be stored in the first memory device which is in particularly a read only memory
device. These memory devices are cheaper and having a faster access time. A further
advantage will be achieved by storing in particular the operating system and the
application system in the same memory. This is an enhancement of the security, since
these data are secured against any changes in respect to virus or other attacks.
Alternatively a Flash memory could be used for storing terminal independent data.

A further reduction of memory requirements is achieved by storing the
individual mobile terminal specific data in the second memory device. So the mobile
terminal does not need to have any kind of further additional reprogrammable and
erasable memory, because all variable data, which are determined after assembling or
manufacturing could be stored on the second memory device, which is disposed in the
SIM card chip.

A mobile terminal has to be calibrated after being assembled. For
calibrating respective components of the mobile terminal certain values have to be
measured and in dependency of the measured values calibration settings are performed.
For instance the resonant circuits of the transmitting and receiving unit have to be
tuned. Further correction settings of high frequency parts of the mobile terminal or
default values, which are depending from the individual mobile terminal, needs to be
set. Since the amount of data is very small, these data will be stored in the second
memory device together with the network, user and identification data. This provides an
improved security and the possibility to exchange data via an end to end
communication.

By storing the individual mobile terminal specific data in the second
memory device together with further user and network depending data the expenses for
manufacturing such mobile terminal will be very low, because only one
reprogrammable memory device is needed.

It is advantageous to arrange an interface unit. By using this interface
unit there will be the possibility to store data in the second memory device after
manufacturing.

The only requirement is that the SIM card chip containing the individual
mobile terminal specific data needs to be assigned to the individual mobile terminal during

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manufacturing. The mobile terminal could only be operated in connection with this unique SIM card chip having the uniquely mobile terminal specific data of this mobile terminal. However, this disadvantage is not really disadvantageous, because in the low price area it is intended to bind the SIM card to the mobile terminal to force the user to use at least for a predetermined period the SIM card of a certain radio network provider.

It is advantageous to mechanically couple the individual SIM card to the mobile terminal during manufacturing, wherein the individual mobile terminal specific data will be stored during manufacturing in the second memory device, which is located on the SIM card chip. The mechanically coupling could be achieved by covering the SIM card by a hardly removable cover. So the SIM card is not accessible without removing the cover of the mobile terminal. So the manufacturer can store the individual mobile terminal specific data on the SIM card. The network provider and the user can access the second memory via the user interface or by using specific tools for removing the cover.

The mobile terminal having the second memory device located on the SIM card requires only the first memory device for storing boot sequence, operation system and application software. So in consequence a low price mobile terminal is provided having reduced components and costs and less power consumption.

In a further advantageous embodiment the mobile terminal does not have a SIM card. Instead of using a SIM card only the SIM card chip is used. The SIM card chip is coupled to the PCB of the mobile terminal. Data which are normally stored via a card reader on the SIM card will be stored via the interface unit in the erasable and programmable second memory device, located on the SIM card chip. By using this embodiment no mechanically coupling between the mobile terminal and the SIM card is required. This will save susceptible parts, e.g. the contacts for accessing the SIM card.

The object will also be solved by a method for manufacturing of a mobile terminal, wherein the mobile terminal comprises a first processing unit and a first memory device and a SIM card chip including a second memory, wherein terminal independent data are stored in the first memory device, the individual mobile terminal specific data, which needs to be provided after assembling or manufacturing of the mobile terminal are stored on the second memory device, which is an reprogrammable

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memory device, data which needs to provided after manufacturing for operating the
mobile terminal are also stored on the second memory device.

5   The invention is described in detail below with reference to the
accompanying schematic drawings, wherein:

           Fig.1 shows a block diagram of a mobile terminal known from the prior
           art;
           Fig. 2 shows a block diagram of a mobile terminal according the present
10   invention;
           Fig. 3 shows a block diagram of an alternative embodiment of a mobile
           terminal according the present invention;

15   Figure 1 represents a known mobile terminal 1. The mobile terminal 1
includes a transmitting and receiving unit 3 having an antenna for communicating with
a base station and a digital signal processor DSP 6. A display unit 4 and a key pad 5 are
arranged for providing a user interface. A first processing unit 7 is also called base band
processor. It controls the operation of the mobile terminal and the interaction between
20   components of the mobile terminal 1. The first processing unit 7 uses a RAM 8 for
storing temporary data. The mobile terminal 1 uses a boot memory 10 for storing a boot
sequence and fixed security setting. This boot memory 10 is a ROM. A further non-
volatile memory is the program memory 14 for storing the operating system,
application software and fixed data. This could be realised as ROM or Flash memory. A
25   SIM card 2 is coupled via a card holder to the mobile terminal 1. Electrical contact
areas (not shown) are provided on the SIM card 2 to access the data stored on the SIM
card chip 23. The SIM card chip 23 comprises a card controller 12 and a card memory
13. The card controller 12 controls the data communication between the SIM card 2 and
the first processing unit 7. The card memory 13 is located on the SIM card chip 23 for
30   storing network settings, an own phone number and user settings. Individual mobile
terminal specific data are stored in an EEPROM or Flash 11, which is located within
the mobile terminal 1. This architecture shows the complexity of different non-volatile

memory devices. In particularly up to four different non-volatile memory devices are used, thereby increasing the number of parts and costs.

A preferred embodiment of the present invention is illustrated in figure 2. The mobile terminal 20 incorporates also a SIM card 2 having a SIM card chip 23

5   including a card controller 12 and a second memory device 22. The first memory device 21 within the mobile terminal 20 is realised as a ROM memory or Flash memory. The first memory device 21 will be programmed before assembling the mobile terminal 20. The data to be stored in the first memory device 21 are fixed and independently from the individual mobile terminal 20. The operating system, application software, the boot

10 sequence and fixed security settings will be stored in first memory device 21. These kinds of data will be the same for a certain model of a mobile terminal. In this inventive embodiment a first non-volatile memory is saved by combining the Boot ROM 1 (Fig.1) and the program memory 14 (Fig.1) and store the respective data together in the first memory device 21.

15   After assembling each mobile terminal 20 has to be adjusted and calibrated. Various measurements will be made, wherein depending on the measurements calibration of the high frequency parts could be performed. The calibration values, correction settings of high frequency parts or default values, which are depending from the individual mobile terminal. These individual mobile terminal

20 specific data are stored in the second memory 22 located in the SIM card chip 23. Also the individual security settings (IMSI, IMEI) will be set. After storing these data the mobile terminal 20 could be distributed to the network provider. The network provider stores the respective network settings in the SIM card 2. It is further possible to store the network settings into the second memory 22 after assembling of the mobile terminal

25 at the production site.

Then the mobile terminal 20 could be provided to the end user. The end user can store any individual user settings in the second memory 22. He has to be informed that the mobile terminal 20 could be operated only with this unique SIM card 2.

30   In comparison to the mobile terminal 1 known from the prior art represented in figure 1 the mobile terminal 20 represented in figure 2 has only two non-volatile memories – the first memory device 21 and the second memory device 22 on

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the SIM card 2.

To avoid a loss of the individual SIM card 2 it may be mechanically locked either after storing the individual mobile terminal specific data during manufacturing or after storing the network settings. This could be achieved by hiding the SIM card 2 using a cover (not shown), which could only be removed using special tools.

The mobile terminal 20 includes an interface unit 9. This interface unit 9 allows accessing the mechanically locked SIM card 2 by using a data cable or IR or Bluetooth communication. So a reprogramming of the SIM card memory 22 is possible, but the removement of the SIM card 2 is not possible. Further it is possible to access the data stored in the second memory 22 via an end to end communication using the mobile radio connection.

Figure 3 shows an alternative embodiment of the present invention. In this embodiment a mobile terminal 30 is provided without a SIM card. The SIM card chip 23 is coupled to the PCB within the mobile terminal 30. The independent data are stored in the first memory device 21, whereas all data determined after assembling could be stored in the second memory device 22 which is located within the SIM card chip 23. This second memory device 22 is realised as EEPROM and could be accessed via the interface unit 9. So the individual mobile terminal specific data, the network settings, the identification settings and the user settings will be written into the second memory device 22 after assembling at the production site, at the distributor or by the end user. It is further possible to incorporate the second memory 22 into an integrated circuit of the mobile terminal 30 in a so called multi package chip (MCP), e.g. in the baseband controller, which is denoted as first processing unit 7.

By providing the inventive mobile terminal a simplified architecture is achieved, which reduces the components, costs and power consumption.